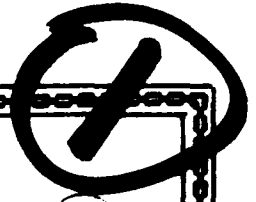


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NATIONAL DAM SAFETY PROGRAM, UPPER HIGHLAND LAKE DAM (NJ00797),--ETC(U)
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TRIBUTARY TO HIGHLAND LAKE
SUSSEX COUNTY
NEW JERSEY

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UPPER HIGHLAND LAKE DAM

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PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.			

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Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

22 JUL 1981

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Upper Highland Lake Dam, Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Upper Highland Lake Dam, a high hazard potential structure, is judged to be in good overall condition. The dam's spillway is considered inadequate, as 59 percent of the Spillway Design Flood (SDF) would cause the dam to be overtopped. The SDF, in this instance, is one half of the Probable Maximum Flood (PMF). Additional hydraulic and hydrologic studies are believed unnecessary since removal of one of three flashboards at the spillway will increase its capacity sufficiently to accommodate the design flood. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. It is recommended that monitoring of the leak begin immediately along with investigations to determine its cause and the remedial action that might be required. In addition, it is recommended that one of the flashboards be permanently removed or that a method be developed which will absolutely guarantee the removal of at least one flashboard for any discharge condition that may be encountered at the spillway.

b. Within twelve months from the date of approval of this report the following remedial actions should be initiated:

(1) Filling and seeding the eroded areas on the crest and downstream slope of the dam. The upstream face should be protected against wave action by the emplacement of riprap along the crest at the water line.

(2) Tree and brush growing on the downstream side of the embankment should be removed.

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Honorable Brendan T. Byrne

(3) If the source of the seep at the toe of the dam cannot be determined, the area should be brought up to the prevailing elevation of the toe utilizing a graded filter material designed to retard flow and prevent the movement of fine material.

(4) All spalled and deteriorated concrete at the spillway should be repaired and the siltation on the upstream side of the weir should be removed.

c. It is recommended that the association's existing work program be expanded to include periodic maintenance of the dam and the development of operational procedures.

d. The owners should develop an emergency action plan and downstream warning system to minimize the potential for flood damage downstream.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



ROGER L. BALDWIN

Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

1 Incl
As stated

Copies furnished:

Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 24 March 1981 by Louis Berger and Associates, Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Upper Highland Lake Dam, a high hazard potential structure, is judged to be in good overall condition. The dam's spillway is considered inadequate, as 59 percent of the Spillway Design Flood (SDF) would cause the dam to be overtopped. The SDF, in this instance, is one half of the Probable Maximum Flood (PMF). Additional hydraulic and hydrologic studies are believed unnecessary since removal of one of three flashboards at the spillway will increase its capacity sufficiently to accommodate the design flood. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. It is recommended that monitoring of the leak begin immediately along with investigations to determine its cause and the remedial action that might be required. In addition, it is recommended that one of the flashboards be permanently removed or that a method be developed which will absolutely guarantee the removal of at least one flashboard for any discharge condition that may be encountered at the spillway.

b. Within twelve months from the date of approval of this report the following remedial actions should be initiated:

(1) Filling and seeding the eroded areas on the crest and downstream slope of the dam. The upstream face should be protected against wave action by the emplacement of riprap along the crest at the water line.

(2) Tree and brush growing on the downstream side of the embankment should be removed.

(3) If the source of the seep at the toe of the dam cannot be determined, the area should be brought up to the prevailing elevation of the toe utilizing a graded filter material designed to retard flow and prevent the movement of fine material.

(4) All spalled and deteriorated concrete at the spillway should be repaired and the siltation on the upstream side of the weir should be removed.

c. It is recommended that the association's existing work program be expanded to include periodic maintenance of the dam and the development of operational procedures.

d. The owners should develop an emergency action plan and downstream warning system to minimize the potential for flood damage downstream.

APPROVED:


ROGER L. BALDWIN

Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

DATE:



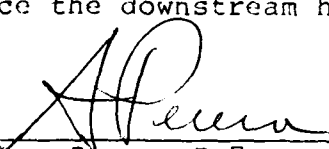
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Upper Highland Lake Dam Fed ID# NJ 00797

State Located New Jersey
County Located Sussex
Coordinates Lat. 4112.7 - Long. 7428.0
Stream Cananea Tributary to Highland Lake
Date of Inspection March 24, 1981

ASSESSMENT OF
GENERAL CONDITIONS

Upper Highland Lake Dam is considered to be in a generally good overall condition although its spillway capacity can accommodate only 58% of the 1/2 PMF design storm. It is recommended that the dam be evaluated within the framework of the high hazard classification due to the high potential for severe property damage and loss of life immediately downstream of the dam. Additional hydraulic and hydrologic studies are believed unnecessary since removal of one of three flashboards at the spillway will increase its capacity sufficiently to accommodate the design flood. Investigations to determine the source of a seep at the downstream toe, and its repair, should begin immediately as should an evaluation of methods to provide for drawdown of the lake. It is recommended that one of the flashboards be removed immediately or that a method be provided that would guarantee removal of a flashboard during periods of high discharge at the spillway. Remedial measures to be undertaken in the near future include the repair of the concrete at the spillway, removal of brush and trees from the embankment, emplacement of riprap on the upstream slope of the dam, repair of the eroded areas on the embankment, and removal of the sedimentation on the upstream side of the spillway weir. It is further recommended that the owner develop an emergency action plan and warning system to reduce the downstream hazard potential.


Abraham Perera P.E.
Project Manager



OVERVIEW OF UPPER HIGHLAND LAKE DAM
MARCH, 1981

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines can be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I investigations is to identify expeditiously those dams that may pose hazards to human life or property. The assessment of the general condition of the dam is based on available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In the review of this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway test flood is based on the estimated "probable maximum flood" for the region (greatest reasonable possible storm runoff) or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

THIS IS INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: UPPER HIGHLAND LAKE DAM
FED. I.D. # NJ 30797

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Corps of Engineers, Philadelphia to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Upper Highland Lake Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Upper Highland Lake Dam is a 311-foot-long earth structure with a concrete spillway located at the left abutment. The embankment has a maximum height of 17.6 feet, a crest width of 15 feet, and a downstream slope of 2H:1V. A 15-foot-wide, 48-foot-long concrete and wooden docking and deck structure extends 21 feet into the lake about 100 feet from the right abutment. The 16.75-foot-wide concrete weir has 2 wooden and 1 steel 8-inch-high flashboards and a steel-truss-supported concrete foot bridge extending between the spillway side-walls. The clear opening at the spillway is presently 19 inches by 16.75 feet. Discharge over the weir drops 6 feet 10 inches to a 20-foot-long concrete apron before entering a small rock-lined stream channel and flowing about 100 feet to a 3-foot by 2-foot oval pipe culvert extending under the community tennis courts.

b. Location

The dam is situated in a small depression on the slopes bordering the west side of Highland Lake; it is located near Highland Lake Road about 500 feet north of its junction with Algonquian Road in Vernon Township, Sussex County, New Jersey. The reservoir is about 175 feet below the crest of Wawayanda Mountain in the north central portion of the community of Highland Lakes and may be reached via Route 515 and Highland Lake Road.

c. Size Classification

The dam has a maximum height of 17.6 feet and a maximum storage capacity of 106 acre-feet. Accordingly, this dam is in the small size category as defined by the criteria in the Recommended Guidelines for Safety Inspection of Dams (storage less than 1,000 acre-feet and height less than 40 feet).

d. Hazard Classification

The dam is located in the middle of extensive residential development in the community of Highland Lakes. The downstream channel decreases in size as it descends the mountain slope and meanders between homes and the residential street system. Community tennis courts are located at the toe of the dam and two homes are situated immediately across the road from the downstream end of the courts. A failure could cause extensive damage to these and other homes and could result in a significant loss of life particularly if the tennis courts were occupied at the time of the failure. Accordingly, it is recommended that this dam be classified as high hazard.

e. Owner

This dam is owned by the Highland Lakes Country Club and Community Association Inc., Highland Lakes, New Jersey.

f. Purpose of Dam

The dam was constructed for the purpose of creating a recreational lake.

g. Design and Construction History

Although there are no engineering or construction records available, other dams created by the same developer in the Highland Lakes community were designed by Newel C. Harrison, Butler, N.J. and constructed by Dollar & VanBlackon, General Contractors of Vernon, N.J. It is possible that the same firms erected this structure.

h. Normal Operating Procedures

There are no formal operating procedures that are applicable to this dam. However, a full-time maintenance staff is employed by the Lake Association for the purpose of groundskeeping and repair.

1.3 PERTINENT DATA

a. Drainage Area

Upper Highland Lake Dam has a drainage area of 0.12 square miles, which consists primarily of woodland and suburban residential development.

b. Total spillway capacity at maximum pool elevation
(top of dam) - 162 cfs

c. Elevations (feet above MSL)

Top of dam - 1,272
Spillway crest - 1,269.8
Streambed at centerline of dam - 1,254.4

d. Reservoir

Length of maximum pool (top of dam) -
820 feet

Length of recreational pool (spillway crest) -
800 feet

e. Storage (acre-feet)

Top of dam - 106.0
Recreation pool - 84.2

f. Reservoir Surface (acres)

Top of dam - 10.6
Recreational pool - 9.2

g. Dam

Type - Earth with concrete spillway at left abutment.

Length - 311 feet

Height - 17.6 feet

Top Width - 15 feet

Side Slopes - 2H:1V downstream; unknown upstream.

Zoning - Unknown

Impervious Core - Unknown

Cutoff - Unknown

Grout Curtain - Unknown

h. Diversion and Regulating Tunnel - None

i. Spillway

Type - Concrete weir with wood and metal flashboards. Trapezoidal channel at right abutment.

Weir Length - 16.75 feet

Gates - None

U/S Channel - Eight-foot-long sand and gravel approach channel.

D/S Channel - Concrete spillway apron about 20 feet long.

j. Regulating Outlets

None - no draw down facilities.

SECTION 1 - ENGINEERING DATA

2.1 DESIGN

A search of various agencies and discussions with the owner's representatives failed to produce any design details, reports, or drawings. All dimensions depicted herein were measured in the field.

2.2 CONSTRUCTION

Although it is believed this dam was constructed by the same contractor that built the other dams in this region, no construction details were available to the inspection team. The contractor could not be located nor were as-built plans available. There are no records of the construction plans having been filed with the NJDEP or of any inspections made by State engineers.

The dam is located in a region underlain by the Pre-Cambrian age Byram gneiss, a dense, hard, and characteristically banded metamorphic granitoid. The reservoir occupies a small, rock-bound depression caused by glacial scouring. The thin overburden in this area consists primarily of silt and organic material.

2.3 OPERATION

No data pertaining to the operation at this dam was obtained (see Section 4).

2.4 EVALUATION

a. Availability

Although the hydraulic and hydrologic conditions could be determined from field measurements and observations, several design criteria could not be evaluated due to a lack of engineering data, including the depth to bedrock, condition of foundation, existence and configuration of a cutoff or corewall, and the relative permeability of the embankment.

b. Adequacy

Although no information pertaining to the dam's internal makeup was obtained, field observations complimented by hydraulic and hydrologic calculations performed by the inspection team, provided sufficient data on which to base an assessment of the dam's overall safety within the purview of PL 92-367.

c. Validity

No design data are available for assessment.

SECTION - VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of Upper Highland Lake Dam (a.k.a. Lake One Dam) was performed on March 24, 1981 at which time the lake level was about 5 inches below the top of the flashboards since the flashboards were wedged open slightly to keep the lake at a lower elevation during the winter. The dam appears to be in generally good condition although some light erosion was noted on the downstream embankment and a substantial seep was observed at the toe of the dam about 100 feet to the right of the spillway.

b. Dam

The dam's embankment is in fairly good condition, although it is slightly uneven horizontally. The back portion of the crest is generally 4 to 6 inches higher than the front as a result of pedestrian traffic. Minor erosion was noted along the upstream edge of the crest, presumably due to wave action, and at two locations on the downstream slope, which appear to be paths. Erosion was also noted adjacent to the spillway wingwall and the concrete portion of the dock and deck structure. While the downstream slope of the embankment has a substantial grass cover, it also supports numerous pine trees, some as large as 18 inches in diameter. A substantial seep was observed slightly beyond the toe of the dam and about 100 feet to the right of the spillway. The seepage area contains a 1-foot-deep standing pool of water that is about 6 feet by 15 feet in areal extent and appears to be about 3 feet lower in elevation than the prevailing dam toe elevation. A wet, leaf-covered channel extends from the seep and intersects the spillway outlet channel near the oval pipe culvert. The water in the seepage pool contains a thick orange precipitate, suggesting the possibility of iron piping in this area, although none was observed or reported at this location.

c. Appurtenant Structures

The spillway and sidewalls are in fair overall condition although some concrete deterioration, consonant with the age of the structure, was observed. Spalling and cracking of the spillway apron was observed, and a horizontal crack extended the width of the spillway about 18 inches below the top of the weir. Spalling was also somewhat more severe at the junction of the spillway slab and apron.

d. Reservoir Area

The terrain surrounding the lake is gently sloping with extensive suburban development to the east and west and less densely developed woodlands to the north. A sandy beach is located at the right abutment and several docks dot the shoreline of the lake. Although not discernible along the face of the dam, there is a sediment build-up at the spillway that extends to within 3 feet of the top of the wingwall. This level is about 7 inches higher than the concrete weir crest and seems to indicate that the lake is always lowered by placing edges between the two lowest flashboards, causing the siltation level to remain at that elevation.

e. Downstream Channel

The downstream channel is small and narrow, extending diagonally from the spillway to the edge of the tennis courts, where it enters a 2-foot by 3-foot CMP culvert that extends under the courts and a road another 150 feet downstream. The terrain surrounding the channel is relatively flat and lightly wooded. The tennis courts located to the right of the channel are 6.1 feet higher in elevation than the culvert invert. The culvert invert is also 4.3 feet lower than the toe of the dam. During extremely high discharges, the area between the tennis courts and the left abutment area must flood due to the relatively small discharge capacity of the culvert. A 6-foot, 8-inch-high timber retaining wall is located at the downstream end of the tennis courts. A local road extends along the bottom of the retaining wall and two homes are located on the opposite side of the road. The channel on the downstream side of the road is deeper and wider with steep side slopes. Several homes are situated near the top of the channel 500 to 700 feet downstream.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no formal operating procedures presently in existence although the Lake Association employs a permanent maintenance crew in addition to seasonal part-time help. This staff is responsible for groundskeeping, preventive maintenance, lake operations, and repairs to the community property, but present operations are restricted by funding limitations.

4.2 MAINTENANCE OF DAM

While the primary responsibility of the maintenance staff centers around groundskeeping, their duties also extend to repair work within their capability. It appears that the dam is presently maintained in an adequate manner, although attention could be concentrated in the area of the growth and light erosion on the embankment backslope.

4.3 MAINTENANCE OF OPERATING FACILITIES

The only regulatory components at the dam are the spillway flashboards. While no formal maintenance procedures exist for this facility, it is apparently repaired on an as-needed basis and does not appear to exhibit any obvious signs of neglect.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

No formal warning system is presently in effect. Although residents living near the dam might observe hazardous conditions during heavy storms and notify local authorities, it was observed that the downstream homes are situated in very vulnerable locations with respect to flood flows. It is believed that only an automated warning system could provide sufficient advance notice downstream in the event of a dam failure.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The present operational procedures and community safeguards are deemed to be inadequate in view of the location and position of the dam and the potential to downstream damage. A general community warning system and emergency action plan should be developed along with a more intensive program of inspection and maintenance.

SECTION 5 - HYDRAULIC HYDROLOGICAL

5.1 EVALUATION OF FEATURES

a. Design Data

In accordance with the criteria presented in the Recommended Guidelines for Safety Inspection of Dams, it has been determined that the Upper Highland Lake Dam is small in size and falls within the high hazard category. Accordingly, the spillway design flood (SDF) was determined by the inspection team to be one-half the probable maximum flood (PMF). The inflow hydrograph was calculated using precipitation data from Technical Paper 40 and Technical Memo NWS Hydro-35. In accordance with Corps of Engineers directives, the inflow hydrograph and flood routing were performed utilizing the HEC-1 computer program. Peak inflow to the reservoir for the 1/2 PMF was 578 cfs. When routed through the reservoir, this flow was reduced to 279 cfs. The spillway capacity before overtopping occurs is 162 cfs and therefore can only accommodate 58% of the design flood. In its present configuration, the spillway capacity is inadequate although not seriously inadequate since the short duration and low velocity of overtopping during the design storm would probably not result in a dam failure. (See paragraph 5.1 d, Overtopping Potential).

b. Experience Data

There were no operational records or experience information available to the inspection team concerning this dam.

c. Visual Observations

There are no indications that the dam has ever been overtopped, although hydraulic calculations indicate overtopping is possible with the 1/2 PMF design storm. The inspection team noted that the spillway flashboards limit the discharge capacity considerably and the steel bridge truss could serve to entrap debris during severe storms, further reducing the ability of the spillway to accommodate heavy storm runoff.

d. Overtopping Potential

Based on the hydraulic evaluation, it appears that the dam could be overtopped by 2.0 inches for approximately 30 minutes during the 1/2 PMP design storm. The maximum velocity of the discharge over the dam would be about 2.25 feet per second which, due to the short duration of the overtopping, would probably not cause significant damage to the dam or result in a dam failure. However it is recommended that the overtopping potential be completely eliminated by the removal of one of the three 8-inch flashboards. This would increase the spillway capacity to 260 cfs and reduce the routed outflow to 220 cfs enabling the spillway to transmit the design storm without overtopping the dam.

e. Drawdown

No draw down facilities were observed at this dam. This is considered a serious deficiency and if, in fact, no blowoff exists, studies should be implemented to determine a feasible method of draining the lake during emergency conditions.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

No deficiencies of a structural nature were noted during the inspection of this dam. The crest is relatively uniform in a horizontal plane, and although the width of the dam crest varies slightly, the maximum height-to-width ratio is relatively modest (1.1:1). No indications of mass movement of material, such as settlement, sloughing, or cracking, were noted. However, the leak observed 100 feet to the right of the spillway has the potential to develop into a more serious problem if left uncorrected.

b. Design and Construction Data

As indicated in Section 2, no information is available regarding the design or construction history of the dam. However, the field observations are considered adequate to render an evaluation of this dam's structural integrity.

c. Operating Records

While no formal operating records are maintained by the lake association, the dam appears to have performed satisfactorily since its construction.

d. Post Construction Changes

There are no records of any structural modifications performed at this dam nor do field observations suggest there have been structural changes since the original construction.

e. Seismic Stability

Upper Highland Lake Dam is located in Seismic Zone 1, where seismic activity is slight and additional structural loading imparted thereby is generally insignificant. Experience indicates that earthen dams in Zone 1 that are stable under static loading conditions will maintain their structural integrity

when subjected to the negligible dynamic loads imposed by the weak seismicity characteristic of this area. As indicated in the preceding paragraphs, this dam is considered statically stable within its present configuration, and it is assumed that it will remain stable during seismic loading.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/
REMEDIAL ACTIONS

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, Upper Highland Lake Dam is judged to be in a generally good condition. However, the spillway is capable of accommodating only 58% of the 1/2 PMF design storm with the flashboards in place. The spillway capacity can be increased to 260 cfs by providing for removal of the top flashboard during periods of high inflow. It is recommended that this dam be placed in the high hazard category due to the high potential for loss of life and severe property damage immediately downstream of the dam.

b. Adequacy of Information

With the exception of visual observations, no information was available for use in evaluating the condition of this dam. Although no data, relative to the composition or construction of the embankment was located, field observations revealed nothing of concern with respect to the condition of the dam. The geometry of the structure is quite uniform and it has a generally well-tended appearance. Accordingly, the information gathered in the field is considered adequate to render an evaluation of the dam's condition within the purview of PL 92-367.

c. Urgency

While implementation of the recommendations pertaining to routine maintenance may be undertaken in the near future, it is felt that monitoring of the leak should begin immediately.

d. Necessity for Further Study

Since removal of one of the three 8-inch flashboards will increase the spillway capacity sufficiently to accommodate the 1/2 PMF design storm, no additional H&H studies are recommended at this

time. However, the source of the leak at the toe of the dam should be investigated to determine if this is, in fact, the location of a low-level blowoff pipe drain. If no drain can be located at the dam, it is recommended that studies be implemented to determine the most feasible manner of providing adequate draw down facilities at the dam.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

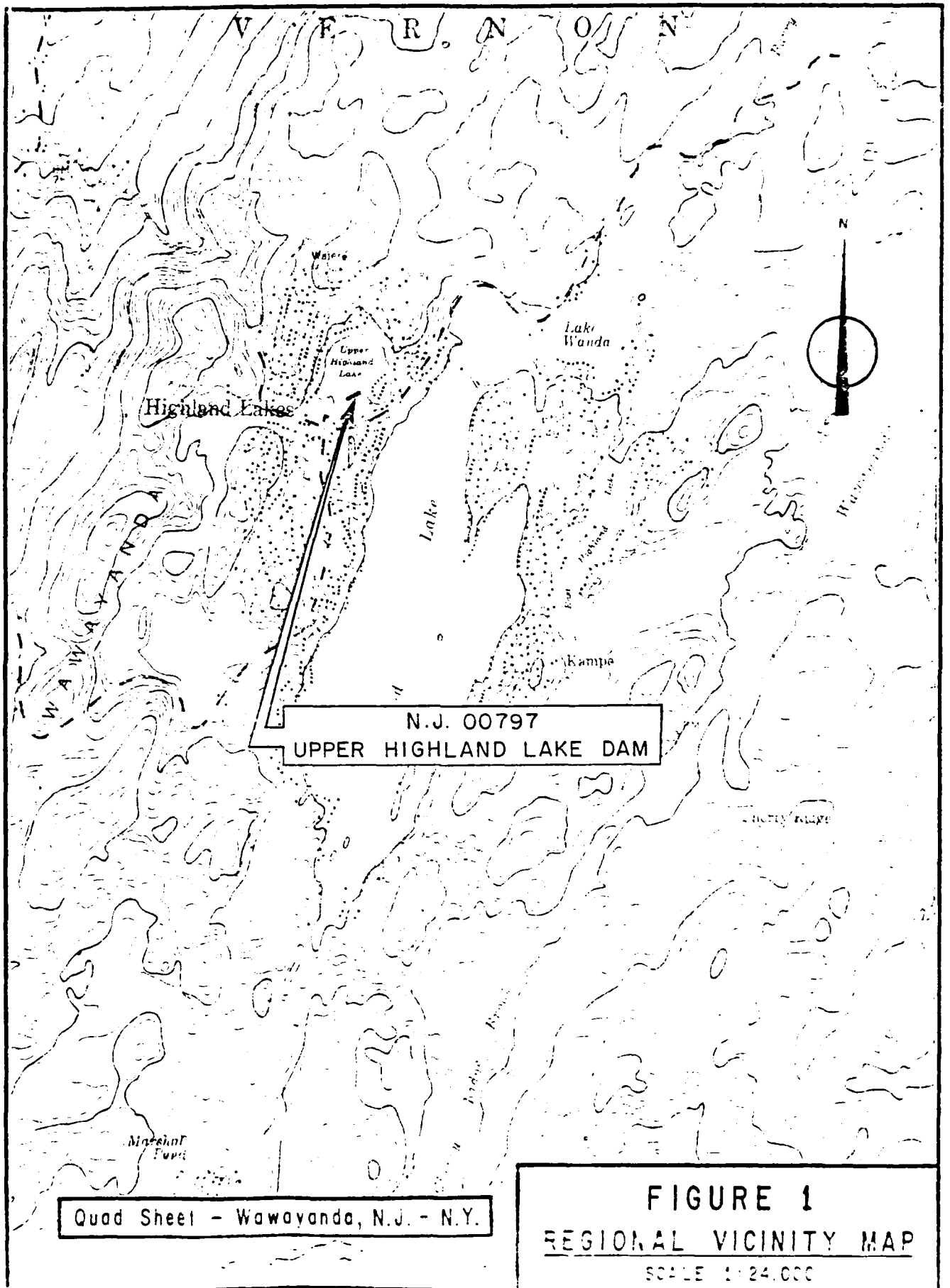
a. Recommendations

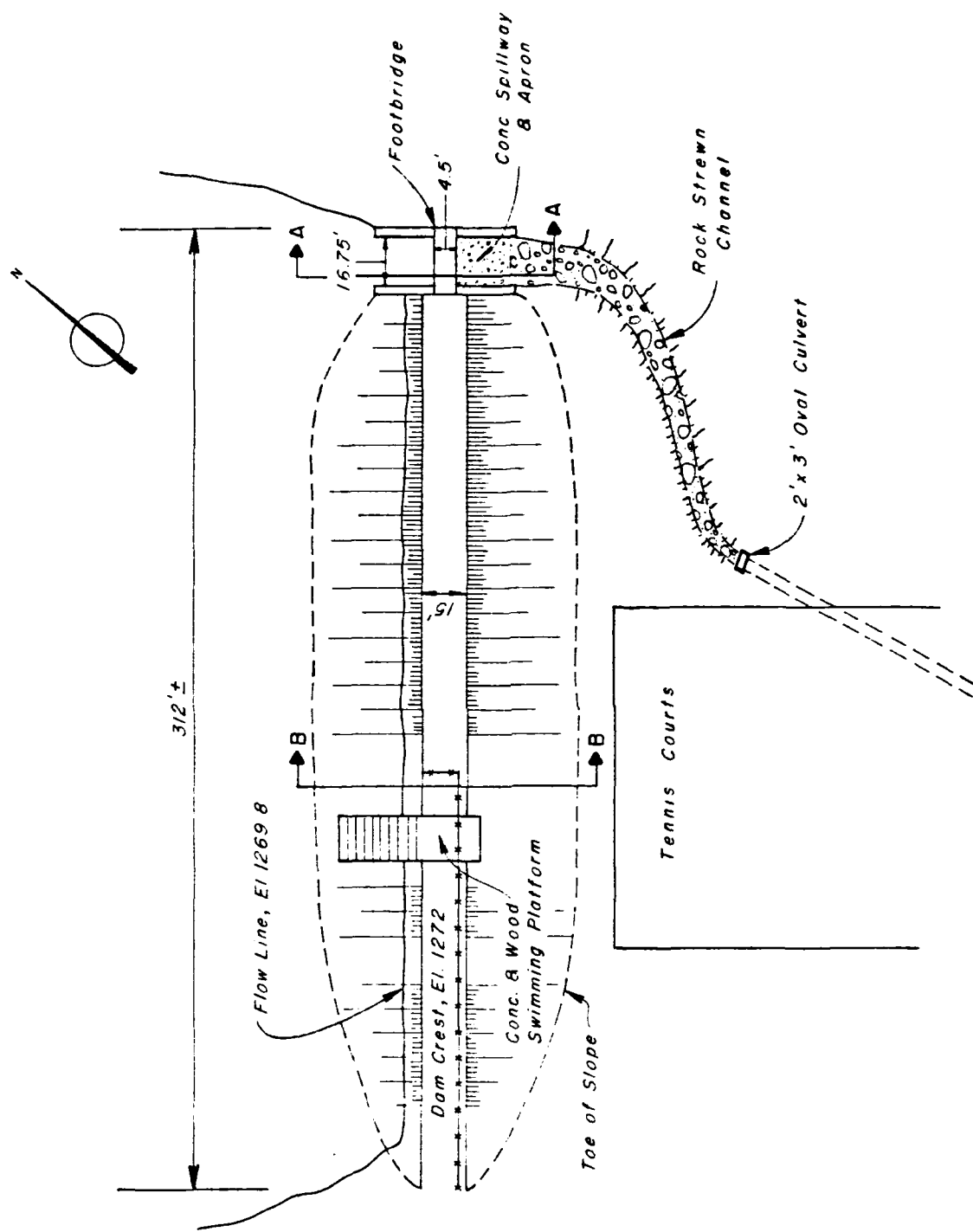
It is recommended that monitoring of the leak begin immediately along with investigations to determine its cause and the remedial action that might be required. In addition, it is recommended that one of the flashboards be permanently removed or that a method be developed which will absolutely guarantee the removal of at least one flashboard for any discharge condition that may be encountered at the spillway. Remedial actions to be performed in the near future include:

- (1) Filling and seeding the eroded areas on the crest and downstream slope of the dam. The upstream face should be protected against wave action by the emplacement of riprap along the crest at the water line.
- (2) Tree and brush growing on the downstream side of the embankment should be removed.
- (3) If the source of the seep at the toe of the dam cannot be determined, the area should be brought up to the prevailing elevation of the toe utilizing a graded filter material designed to retard flow and prevent the movement of fine material.
- (4) All spalled and deteriorated concrete at the spillway should be repaired and the siltation on the upstream side of the weir should be removed.

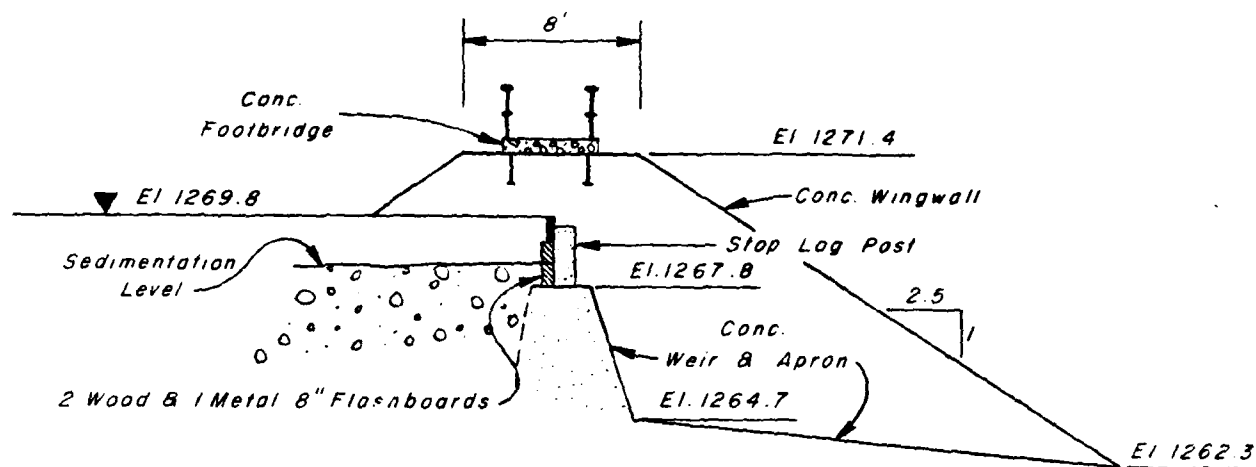
b. O&M Maintenance and Procedures

It is recommended that the association's existing work program be expanded to include periodic maintenance of the dam and the development of operational procedures. The owners should develop an emergency action plan and downstream warning system to minimize the potential for flood damage downstream.

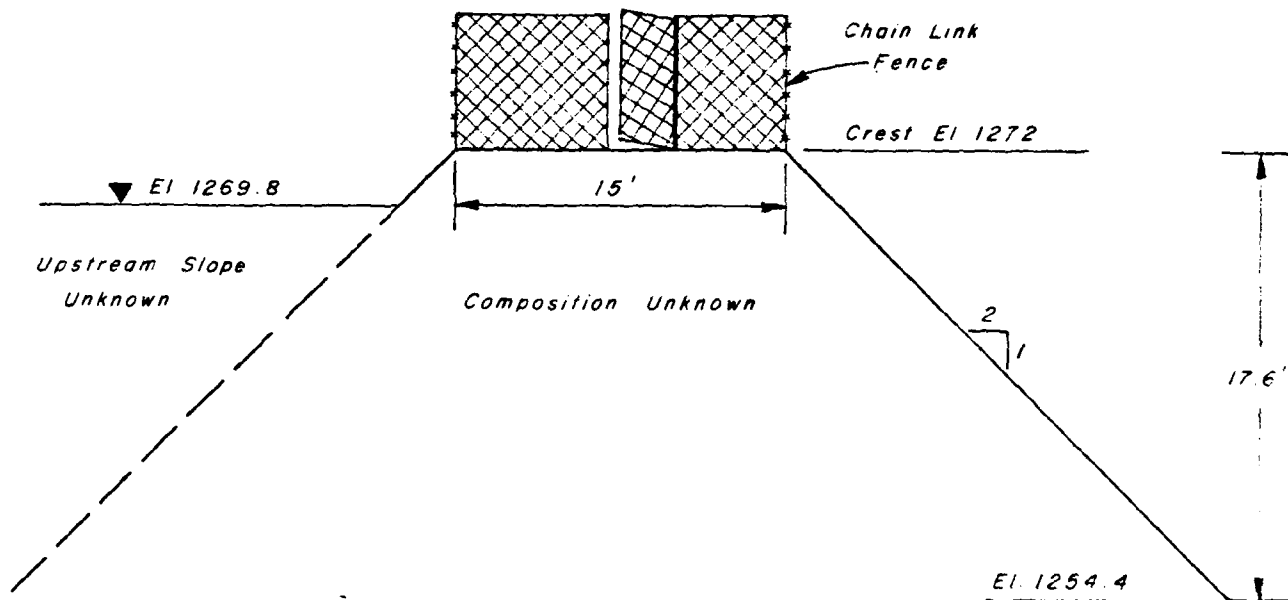




PLAN OF UPPER
HIGHLAND LAKE DAM
NOT TO SCALE



SECTION A-A
SPILLWAY ELEVATIONS
NOT TO SCALE



SECTION B-B
EMBANKMENT ELEVATIONS
NOT TO SCALE

UPPER HIGHLAND LAKE DAM

FIGURE 3

Check List
Visual Inspection
Phase 1

Name Dam Upper Highland Lake County Sussex State New Jersey Coordinators NDEP

Date(s) Inspection 3-24-81 Weather Sunny Temperature 40°

Pool Elevation at Time of Inspection 1269.4 M.S.L. Tailwater at Time of Inspection 1260.7 M.S.L.

Inspection Personnel:

T. Chapter

A. Perera

Representative of owner not present.

A. Perera Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UPRIVAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SCOPES	Light erosion downstream.	Appear to be paths. Should be filled.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal and vertical alignment slightly irregular.	Vertical alignment irregularity apparently due to wear from foot traffic. Horizontal alignment irregularities due to wave and ice action.
RIPEAP FAILURES	N/A ii	No riprap observed

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Numerous tall pines up to 18" in diameter on the downstream slope.	Should be removed.
SECTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND INH	Embankment grades uniformly into adjacent slopes.	No cracking or separations observed.
ANY NOTICEABLE SEEPAGE	Heavy seepage at toe of dam approximately 100 feet from left abutment. Seepage pool approximately 15 x 6 feet and 1 foot deep. Orange precipitate in seepage.	Site of seepage is approximately 3 feet lower than prevalent dam toe elevation. Seepage should be monitored.
STAFF GAGE AND RECORDER	None observed	
PPAIES	None observed iii	Stone surface around edge of tennis court.

UNCATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Downstream face of weir scaling. Light spalling and efflorescence on left downstream wingwall; others satisfactory.	Repair deteriorated concrete.
APPROACH CHANNEL	Lake bottom sandy silt and gravel.	Silted to within 3 feet of top of wingwalls. Should be cleaned.
DISCHARGE CHANNEL	Channel is narrow (3 to 5 feet wide), approximately 2 feet deep, and filled with small boulders; banks are wooded.	Channel ends in 2' x 3' oval culvert, which appears to be a severe constriction during heavy storms.
BRIDGE AND PIERS	Steel truss of concrete footbridge may collect debris and constrict discharge. Bridge appears to hamper removal of flashboards.	Spillway should be monitored during heavy storms and kept free of debris. Method of removing flashboards should be devised.
	iv	

INSTRUMENTATION

VISUAL EXAMINATION DOCUMENTATION/SURVEYS	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
	None	
OBSERVATION WELLS	None	
WELLS	None	
PIEZOMETERS	None	
OTHER	v	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SHORES	Slopes gentle, beaches and wooded.	Homes surrounding lake, several docks.
SEDIMENTATION	Siltation observed in approach channel to spillway.	
	vi	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CORROSION (OBSTRUCTIONS, DEBRIS, ETC.)	Narrow, rocky channel in flat area adjoining tennis courts. Channel enters 2' x 3' oval culvert about 100 feet downstream. Road about 250 feet downstream 6'-7' lower in elevation than tennis courts.	Road and tennis courts would be inundated in event of dam failure.
SLOPES	Very flat downstream area about 300 feet wide. Side slopes gentle.	
APPROXIMATE NO. OF TREES AND POPULATION	Two homes located directly across street from tennis court. Several homes adjacent to stream channel 500-700 feet downstream.	Tennis courts and homes adjacent to road would be seriously damaged by flood. Homes near downstream channel could also be endangered.
	vii	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	None Available
REGIONAL VICINITY MAP	USGS Quadrangle - Wawayunda N.J. - N.Y.
CONSTRUCTION HISTORY	None Available
TYPICAL SECTIONS OF DAM	None Available
HYDROLOGIC/HYDRAULIC DATA	None Available
OUTLETS - PLAN	None Available
- DETAILS	None Available
- CONSTRAINTS	None Available
- DISCHARGE RATINGS	None Available
RAINFALL/RESERVOIR RECORDS	None Available

TITLE		REMARKS
SPILLWAY PLAN		None Available
SECTIONS		None Available
DETAILS		None Available
OPERATING EQUIPMENT		None Available
PLANS & DETAILS		None Available

ITEM REMARKS

DESIGN REPORTS

None Available

GEOLOGY REPORTS

None Available

DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES

None Available
None Available
None Available
None Available

MATERIALS INVESTIGATIONS POREING RECORDS LABORATORY FIELD

None Available
None Available
None Available
None Available

POST-CONSTRUCTION SURVEYS OF DAM

None Available

BORROW SOURCES.

Unknown

x

ITEM	REMARKS
------	---------

MONITORING SYSTEMS

None

MODIFICATIONS

Information Not Available

HIGH POOL RECORDS

Information Not Available

POST CONSTRUCTION ENGINEERING
STUDIES AND REPORTS

Information Not Available
Information Not Available

PRIOR ACCIDENTS OR FAILURE OF DAM
DESCRIPTION
REPORTS

Information Not Available
Information Not Available
Information Not Available

MAINTENANCE
OPERATION
RECORDS

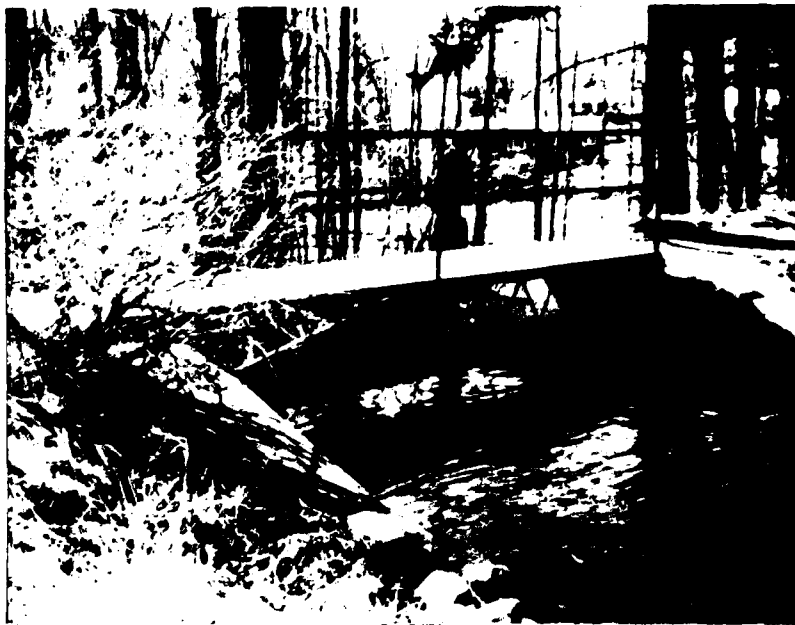
Information Not Available
Information Not Available
Information Not Available



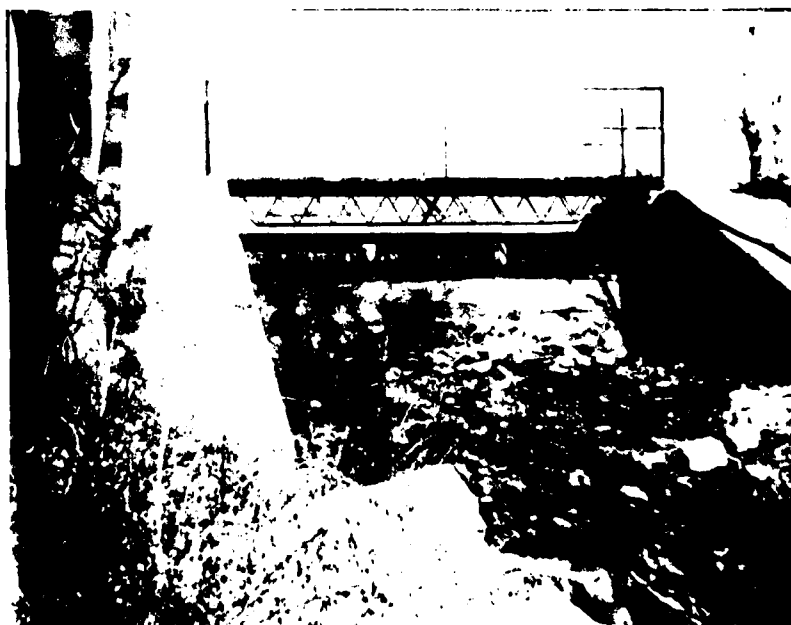
March, 1981
Dam Crest Looking Southwest



March, 1981
Dam Crest Looking Northeast



March, 1981
Upstream View of Spillway



March, 1981
Downstream View of Spillway



March, 1981

Seepage at Downstream Toe



March, 1981

Downstream Channel and Pipe Culvert

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 0.12 sq. mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1269.8 NGVD (24.0 ac.ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): -

ELEVATION MAXIMUM DESIGN POOL: -

ELEVATION TOP DAM: 1272 NGVD (106.0 acre-feet)

CREST: Spillway

- a. Elevation 1267.8 NGVD (Top of concrete weir)
- b. Type Concrete Weir
- c. Width Approximately 24 inches
- d. Length 16.75 feet
- e. Location Spillover Left Abutment
- f. Number and Type of Gates Three 8-inch-high flashboards

OUTLET WORKS: None observed

- a. Type _____
- b. Location _____
- c. Entrance inverts _____
- d. Exit inverts _____
- e. Emergency draindown facilities _____

HYDROMETEOROLOGICAL GAGES: None

- a. Type _____
- b. Location _____
- c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE: 162 cfs

SHEET NO. 4 OF 5

PROJECT

Drummond, John = 7500, 5' 11" x 160 lbs. handsome, 30-40, white.

2. $\sigma_{\text{max}} = 100 \text{ MPa}$

$$\Delta \frac{1}{2} \text{ gms} = 26.5 \text{ gms} \cdot 10\% = 2.65 \text{ gms} = 0.00265 \text{ kg} = 0.7 \text{ lb}$$

From Director of Social Service

Assume C_{max} velocity = 4 ft/s. $t_{\text{c}} = 0.0001$ sec.

Spencer, Fla

Length = 600'

$$\Delta r = 120 - 100 = 100' \text{, Slope } = \frac{100}{160} = 0.625'$$

From Deering to ... Deering ...

Pres. over a Fla. Nat. Club. 1907. 1908. 1909. 1910. 1911. 1912. 1913. 1914. 1915. 1916. 1917. 1918. 1919. 1920. 1921. 1922. 1923. 1924. 1925. 1926. 1927. 1928. 1929. 1930. 1931. 1932. 1933. 1934. 1935. 1936. 1937. 1938. 1939. 1940. 1941. 1942. 1943. 1944. 1945. 1946. 1947. 1948. 1949. 1950. 1951. 1952. 1953. 1954. 1955. 1956. 1957. 1958. 1959. 1960. 1961. 1962. 1963. 1964. 1965. 1966. 1967. 1968. 1969. 1970. 1971. 1972. 1973. 1974. 1975. 1976. 1977. 1978. 1979. 1980. 1981. 1982. 1983. 1984. 1985. 1986. 1987. 1988. 1989. 1990. 1991. 1992. 1993. 1994. 1995. 1996. 1997. 1998. 1999. 2000. 2001. 2002. 2003. 2004. 2005. 2006. 2007. 2008. 2009. 2010. 2011. 2012. 2013. 2014. 2015. 2016. 2017. 2018. 2019. 2020. 2021. 2022. 2023. 2024. 2025. 2026. 2027. 2028. 2029. 2030. 2031. 2032. 2033. 2034. 2035. 2036. 2037. 2038. 2039. 2040. 2041. 2042. 2043. 2044. 2045. 2046. 2047. 2048. 2049. 2050. 2051. 2052. 2053. 2054. 2055. 2056. 2057. 2058. 2059. 2060. 2061. 2062. 2063. 2064. 2065. 2066. 2067. 2068. 2069. 2070. 2071. 2072. 2073. 2074. 2075. 2076. 2077. 2078. 2079. 2080. 2081. 2082. 2083. 2084. 2085. 2086. 2087. 2088. 2089. 2090. 2091. 2092. 2093. 2094. 2095. 2096. 2097. 2098. 2099. 2100. 2101. 2102. 2103. 2104. 2105. 2106. 2107. 2108. 2109. 2110. 2111. 2112. 2113. 2114. 2115. 2116. 2117. 2118. 2119. 2120. 2121. 2122. 2123. 2124. 2125. 2126. 2127. 2128. 2129. 2130. 2131. 2132. 2133. 2134. 2135. 2136. 2137. 2138. 2139. 2140. 2141. 2142. 2143. 2144. 2145. 2146. 2147. 2148. 2149. 2150. 2151. 2152. 2153. 2154. 2155. 2156. 2157. 2158. 2159. 2160. 2161. 2162. 2163. 2164. 2165. 2166. 2167. 2168. 2169. 2170. 2171. 2172. 2173. 2174. 2175. 2176. 2177. 2178. 2179. 2180. 2181. 2182. 2183. 2184. 2185. 2186. 2187. 2188. 2189. 2190. 2191. 2192. 2193. 2194. 2195. 2196. 2197. 2198. 2199. 2200. 2201. 2202. 2203. 2204. 2205. 2206. 2207. 2208. 2209. 2210. 2211. 2212. 2213. 2214. 2215. 2216. 2217. 2218. 2219. 2220. 2221. 2222. 2223. 2224. 2225. 2226. 2227. 2228. 2229. 2230. 2231. 2232. 2233. 2234. 2235. 2236. 2237. 2238. 2239. 2240. 2241. 2242. 2243. 2244. 2245. 2246. 2247. 2248. 2249. 2250. 2251. 2252. 2253. 2254. 2255. 2256. 2257. 2258. 2259. 2260. 2261. 2262. 2263. 2264. 2265. 2266. 2267. 2268. 2269. 2270. 2271. 2272. 2273. 2274. 2275. 2276. 2277. 2278. 2279. 2280. 2281. 2282. 2283. 2284. 2285. 2286. 2287. 2288. 2289. 2290. 2291. 2292. 2293. 2294. 2295. 2296. 2297. 2298. 2299. 2300. 2301. 2302. 2303. 2304. 2305. 2306. 2307. 2308. 2309. 2310. 2311. 2312. 2313. 2314. 2315. 2316. 2317. 2318. 2319. 2320. 2321. 2322. 2323. 2324. 2325. 2326. 2327. 2328. 2329. 2330. 2331. 2332. 2333. 2334. 2335. 2336. 2337. 2338. 2339. 2340. 2341. 2342. 2343. 2344. 2345. 2346. 2347. 2348. 2349. 2350. 2351. 2352. 2353. 2354. 2355. 2356. 2357. 2358. 2359. 2360. 2361. 2362. 2363. 2364. 2365. 2366. 2367. 2368. 2369. 2370. 2371. 2372. 2373. 2374. 2375. 2376. 2377. 2378. 2379. 2380. 2381. 2382. 2383. 2384. 2385. 2386. 2387. 2388. 2389. 2390. 2391. 2392. 2393. 2394. 2395. 2396. 2397. 2398. 2399. 2400. 2401. 2402. 2403. 2404. 2405. 2406. 2407. 2408. 2409. 2410. 2411. 2412. 2413. 2414. 2415. 2416. 2417. 2418. 2419. 2420. 2421. 2422. 2423. 2424. 2425. 2426. 2427. 2428. 2429. 2430. 2431. 2432. 2433. 2434. 2435. 2436. 2437. 2438. 2439. 2440. 2441. 2442. 2443. 2444. 2445. 2446. 2447. 2448. 2449. 2450. 2451. 2452. 2453. 2454. 2455. 2456. 2457. 2458. 2459. 2460. 2461. 2462. 2463. 2464. 2465. 2466. 2467. 2468. 2469. 2470. 2471. 2472. 2473. 2474. 2475. 2476. 2477. 2478. 2479. 2480. 2481. 2482. 2483. 2484. 2485. 2486. 2487. 2488. 2489. 2490. 2491. 2492. 2493. 2494. 2495. 2496. 2497. 2498. 2499. 2500. 2501. 2502. 2503. 2504. 2505. 2506. 2507. 2508. 2509. 2510. 2511. 2512. 2513. 2514. 2515. 2516. 2517. 2518. 2519. 2520. 2521. 2522. 2523. 2524. 2525. 2526. 2527. 2528. 2529. 2530. 2531. 2532. 2533. 2534. 2535. 2536. 2537. 2538. 2539. 2540. 2541. 2542. 2543. 2544. 2545. 2546. 2547. 2548. 2549. 2550. 2551. 2552. 2553. 2554. 2555. 2556. 2557. 2558. 2559. 2560. 2561. 2562. 2563. 2564. 2565. 2566. 2567. 2568. 2569. 2570. 2571. 2572. 2573. 2574. 2575. 2576. 2577. 2578. 2579. 2580. 2581. 2582. 2583. 2584. 2585. 2586. 258

$$T_{\text{res}} = T_c = 5 + 3 \times 10 = 35 \text{ m}$$

Meeting: Science & Culture 1991

Reference to $\left(\frac{11.2}{-3.1} \cdot 10^{-10} = \frac{11.2 \cdot 10^{-10}}{-3.1} \right)^{1/2} = 1.9341$

Spoken to 3 m. : 55 m.

T₁ T₂ .13 .14

Material: 3 SCS Material Source: SC-7, SC

40.10.10 Soil sample 1 E 60.14.10.10 T₁ 10 80

CN = 66

OK. ✓ = 0.5.

$$S = \frac{1000}{50} - 10 = 20 - 10 = 10$$

$\Delta t_{\text{travel}} \text{ to } t_0 = 1500'$

$$Z = Z_0 = \frac{2^{1.5} (5 + j1)^2}{(120 \times 10^{-9})} = \frac{15.49 \angle 61.5^\circ}{(120 \times 10^{-9})} = \frac{(24)(10^7)}{5.76} = 0.4166$$

$$\tau_c = L_{cr} / c = .21 / .6 = .35$$

$$A_{\text{TC}} = \frac{A_{\text{TC}} + A_{\text{TC}}}{2} = 1.04 \text{ m}$$

$$-1.2 - 1.2 = -2.4$$

7. 11. 1952. 10. 52. 10. 52. 10. 52.

BY LLS DATE 2/28/83

LOUIS BERGER & ASSOCIATES INC.

SHEET NO 12 OF 15

CHKD. BY _____ DATE _____

PROJECT 45-270

SUBJECT _____

TELETYPE DATA

TELETYPE DATA MONITORING RESULTS FOR 20.0000 HRS
AND 24 HOUR (IN INCH)

MAX IN INCH 2.9

FOR GRAVITY ALCH 112.50 IN

MIN MAX 6 HOUR PERCENTAGE = 111%

MAX MAX 12 HOUR PERCENTAGE = 123%

MAX MAX 24 HOUR PERCENTAGE = 134%

BY: DATE: 10/1/79

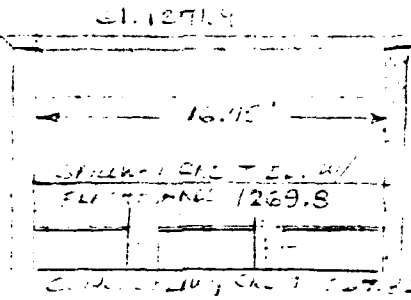
LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 1 OF 1

CHKD. BY: DATE:

PROJECT:

SUBJECT:



$$2 \times 16.75' \times 1269.8' = 425'$$

FLOOR OVER	SPILLWAY	FLOOR OVER	FLOOR OVER	TOTAL
16.75'	16.75'	16.75'	16.75'	
1269.8'	1269.8'	1269.8'	1269.8'	
16.75'	16.75'	16.75'	16.75'	
1269.8'	1269.8'	1269.8'	1269.8'	
16.75'	16.75'	16.75'	16.75'	
1269.8'	1269.8'	1269.8'	1269.8'	

16.75'	16.75'	16.75'	16.75'	16.75'
1269.8'	1269.8'	1269.8'	1269.8'	1269.8'
16.75'	16.75'	16.75'	16.75'	16.75'
1269.8'	1269.8'	1269.8'	1269.8'	1269.8'
16.75'	16.75'	16.75'	16.75'	16.75'
1269.8'	1269.8'	1269.8'	1269.8'	1269.8'
16.75'	16.75'	16.75'	16.75'	16.75'
1269.8'	1269.8'	1269.8'	1269.8'	1269.8'
16.75'	16.75'	16.75'	16.75'	16.75'
1269.8'	1269.8'	1269.8'	1269.8'	1269.8'

ENTRANCE

ENTRANCE

BY: L. Berger DATE: 4/27/61

CHKD. BY: _____ DATE: _____

SUBJECT: STAGE - 2nd

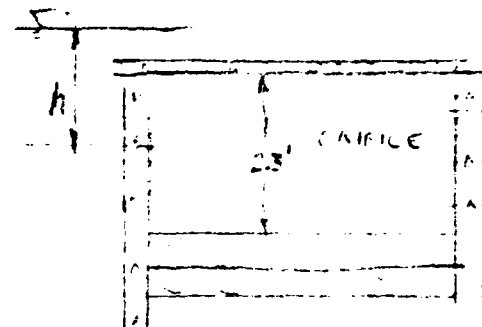
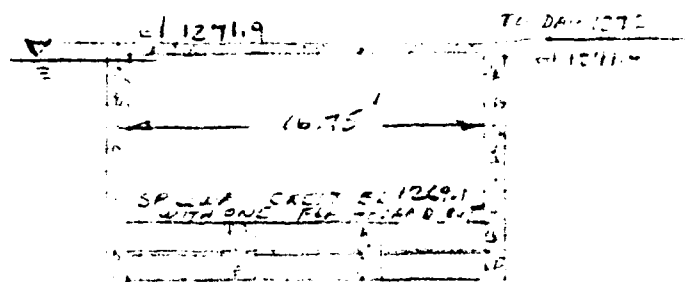
LOUIS BERGER & ASSOCIATES INC.

Upper Harbor Lake, LA

SHEET NO. 45 OF 45

PROJECT: SEWER

SUBJECT: STAGE - 2nd



Flow Over Spillway Weir
 when down to 1269.1
 Crest Elevation 1269.1 L=16.75
 $Q = C L H^{3/2}$ (WEIR)
 $Q = C L H^{5/2}$ (ORIFICE)

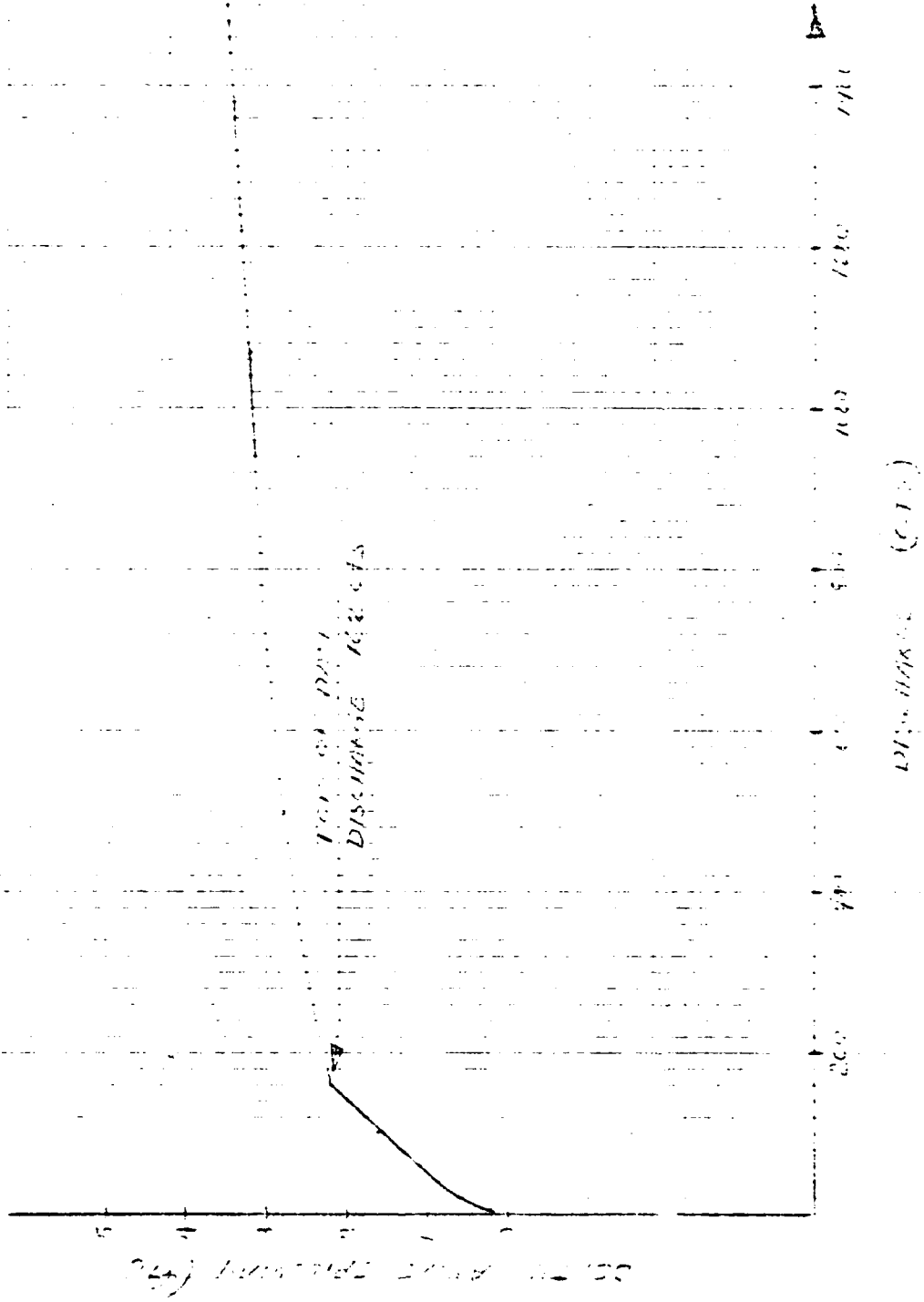
Flow over
 Footbridge
 L=16.75
 $Q = C L H^{3/2}$

Flow over Dam
 when down to 1269.1
 Crest Elevation 1269.1 L=16.75
 $Q = C L H^{3/2}$

TOTAL
 Flow

ELEVATION	H	C	Q	H	C	Q	H	C	Q	
1269.1	0	3.2	0							0
1270.0	.9	3.2	46							46
1271.0	1.9	3.2	140							140
1271.4	2.3	3.2	197							197
ORIFICE										
1271.5	1.65	.63	250	0		0				250
1272.0	1.75	.63	259	.1	2.8	0	0			259
1272.5	2.25	.63	292	.6	2.8	22	.5	2.8	297	301
1273.0	2.75	.63	333	1.1	0	0	1	2.8	310	333
1274.0	3.75	.63	377	2.1	0	0	2	2.8	329	377

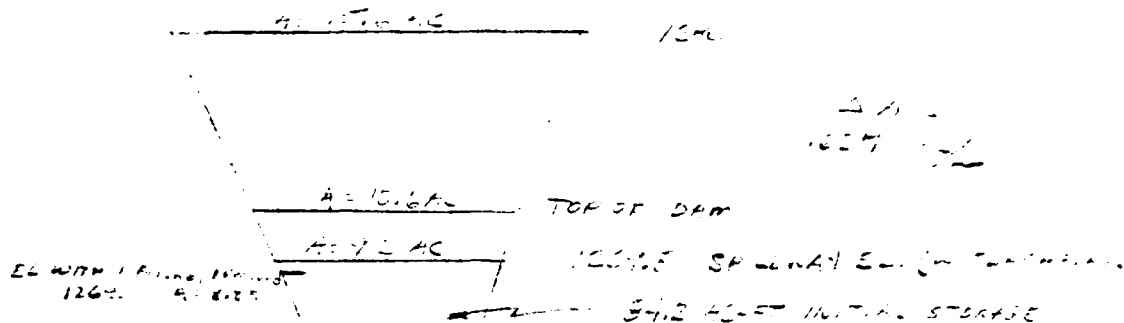
Upper Highland Lake Dam
STAGE - DISCHARGE CURVE



BY LS DATE 2/2/78
 CHKD. BY DATE
 SUBJECT STILLAGE

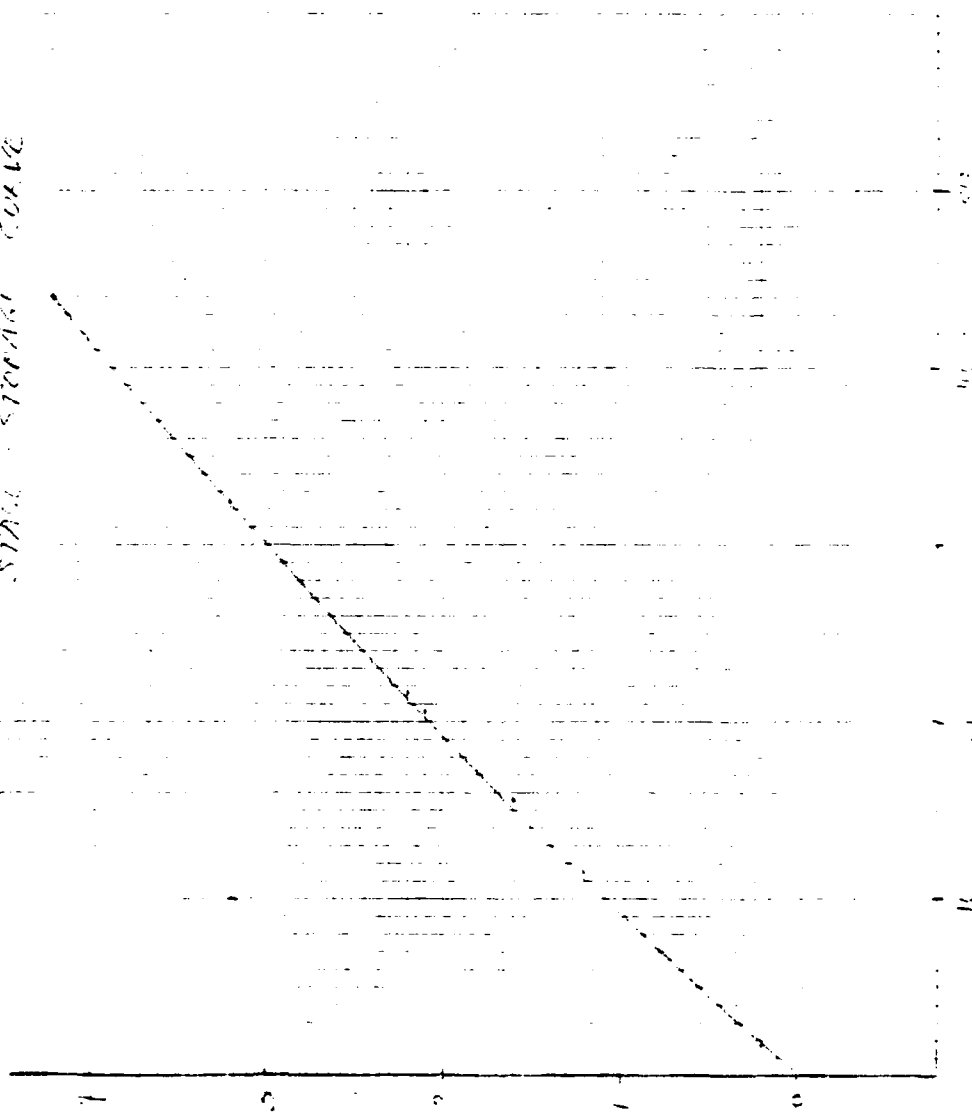
LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 4 OF 10
 PROJECT STILLAGE



ELEVATION		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
1356.0		1356 (A. J. 1356.0)		1356 (A. J. 1356.0)	
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1356					

Upper Humber Lake Dam
SIDE - STORAGE CURVE



HEIGHT ABOVE OUTLET (ft)

100'

80'

60'

40'

20'

0'

SHEET NO. 1 OF 1

PROJECT _____

JOB SPECIFICATION

INFLOW HYDROGRAPH TO RESERVOIR

ISTAG	ICOMP	IECDIN	ITAFE	JPLT	JFRT	INAME	ISTAGE	IAUTG
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

THYD	LUH	TAREA	SNAP	TRCDA	TRSPC	RATIO	ISNDW	ISAME	LOCAL
1	1	0 12	0 00	0 12	0 00	0.000	0	0	0

LOSS DATA

LROPT	STKR	DLTK	RTID	ERAIN	STKR	RTID	STRT	CHST	ALMA	FTIMP
0	0 00	0 00	1 00	0 00	0 00	1 00	0 50	0 10	0 00	0 00

UNIT HYDROGRAPH DATA

(TIME INCREMENT TOO LARGE--(NHG IS GT LAG/2)) LEAVE INCREMENT, AS IT IS
PER GEORGE SAULS

SUB-AREA RUNOFF COMPUTATION

REFCIP DATA

DATE	ENG	R6	R17	R24	R49	R72	R76
0 00	01 50	111 00	126 00	134 00	0 00	0 00	0 00

1989: COLLECTED BY THE PROGRAM IN 1989

10 - 0 0 - 1 4 - 0 12

EXPERIMENTAL DATA

01102- 0 02 00000- 0 00 01102- 1 00

UNIT HXAG004000 0 00000 PERIOD ORIGINATES. TC= 0 00 HOURS. LAG= 0 12 VOL= 1 00

213	324	140	96	21	9	5	1
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[illegible]

SHEET NO. 1 OF 12
PROJECT: S. 10-1

SUBJECT _____

PROJECT _____

SHEET NO. 41 OF 47
PROJECT 627

540	50 46	21 12	506	16326
	(526)	(536)	(507)	442 251
15 09				
4 00				
21 11				
540 15				
135				
167				

DIBROMODIPHENYL AT STA		1,6-DI(4-FLUOROPHENYL)	
ν , cm^{-1}	ϵ	ν , cm^{-1}	ϵ
645	15	645	1
680	15	680	1
716	2	716	10
737	237	737	260
751	69	751	260
769	69	769	26
781	74	781	23

3376A: 15, 30, 45, 60, 75, 90, 105, 120, 135, 150, 165, 180, 195, 210, 225, 240, 255, 270, 285, 300, 315, 330, 345, 360, 375, 390, 405, 420, 435, 450, 465, 480, 495, 510, 525, 540, 555, 570, 585, 600, 615, 630, 645, 660, 675, 690, 705, 720, 735, 750, 765, 780, 795, 810, 825, 840, 855, 870, 885, 900, 915, 930, 945, 960, 975, 990, 1005, 1020, 1035, 1050, 1065, 1080, 1095, 1110, 1125, 1140, 1155, 1170, 1185, 1200, 1215, 1230, 1245, 1260, 1275, 1290, 1305, 1320, 1335, 1350, 1365, 1380, 1395, 1410, 1425, 1440, 1455, 1470, 1485, 1500, 1515, 1530, 1545, 1560, 1575, 1590, 1605, 1620, 1635, 1650, 1665, 1680, 1695, 1710, 1725, 1740, 1755, 1770, 1785, 1800, 1815, 1830, 1845, 1860, 1875, 1890, 1905, 1920, 1935, 1950, 1965, 1980, 1995, 2010, 2025, 2040, 2055, 2070, 2085, 2100, 2115, 2130, 2145, 2160, 2175, 2190, 2205, 2220, 2235, 2250, 2265, 2280, 2295, 2310, 2325, 2340, 2355, 2370, 2385, 2400, 2415, 2430, 2445, 2460, 2475, 2490, 2505, 2520, 2535, 2550, 2565, 2580, 2595, 2610, 2625, 2640, 2655, 2670, 2685, 2700, 2715, 2730, 2745, 2760, 2775, 2790, 2805, 2820, 2835, 2850, 2865, 2880, 2895, 2910, 2925, 2940, 2955, 2970, 2985, 3000, 3015, 3030, 3045, 3060, 3075, 3090, 3105, 3120, 3135, 3150, 3165, 3180, 3195, 3210, 3225, 3240, 3255, 3270, 3285, 3300, 3315, 3330, 3345, 3360, 3375, 3390, 3405, 3420, 3435, 3450, 3465, 3480, 3495, 3510, 3525, 3540, 3555, 3570, 3585, 3600, 3615, 3630, 3645, 3660, 3675, 3690, 3705, 3720, 3735, 3750, 3765, 3780, 3795, 3810, 3825, 3840, 3855, 3870, 3885, 3900, 3915, 3930, 3945, 3960, 3975, 3990, 4005, 4020, 4035, 4050, 4065, 4080, 4095, 4110, 4125, 4140, 4155, 4170, 4185, 4200, 4215, 4230, 4245, 4260, 4275, 4290, 4305, 4320, 4335, 4350, 4365, 4380, 4395, 4410, 4425, 4440, 4455, 4470, 4485, 4500, 4515, 4530, 4545, 4560, 4575, 4590, 4605, 4620, 4635, 4650, 4665, 4680, 4695, 4710, 4725, 4740, 4755, 4770, 4785, 4800, 4815, 4830, 4845, 4860, 4875, 4890, 4905, 4920, 4935, 4950, 4965, 4980, 4995, 5010, 5025, 5040, 5055, 5070, 5085, 5100, 5115, 5130, 5145, 5160, 5175, 5190, 5205, 5220, 5235, 5250, 5265, 5280, 5295, 5310, 5325, 5340, 5355, 5370, 5385, 5400, 5415, 5430, 5445, 5460, 5475, 5490, 5505, 5520, 5535, 5550, 5565, 5580, 5595, 5610, 5625, 5640, 5655, 5670, 5685, 5700, 5715, 5730, 5745, 5760, 5775, 5790, 5805, 5820, 5835, 5850, 5865, 5880, 5895, 5910, 5925, 5940, 5955, 5970, 5985, 6000, 6015, 6030, 6045, 6060, 6075, 6090, 6105, 6120, 6135, 6150, 6165, 6180, 6195, 6210, 6225, 6240, 6255, 6270, 6285, 6300, 6315, 6330, 6345, 6360, 6375, 6390, 6405, 6420, 6435, 6450, 6465, 6480, 6495, 6510, 6525, 6540, 6555, 6570, 6585, 6600, 6615, 6630, 6645, 6660, 6675, 6690, 6705, 6720, 6735, 6750, 6765, 6780, 6795, 6810, 6825, 6840, 6855, 6870, 6885, 6900, 6915, 6930, 6945, 6960, 6975, 6990, 7005, 7020, 7035, 7050, 7065, 7080, 7095, 7110, 7125, 7140, 7155, 7170, 7185, 7200, 7215, 7230, 7245, 7260, 7275, 7290, 7305, 7320, 7335, 7350, 7365, 7380, 7395, 7410, 7425, 7440, 7455, 7470, 7485, 7500, 7515, 7530, 7545, 7560, 7575, 7590, 7605, 7620, 7635, 7650, 7665, 7680, 7695, 7710, 7725, 7740, 7755, 7770, 7785, 7800, 7815, 7830, 7845, 7860, 7875, 7890, 7905, 7920, 7935, 7950, 7965, 7980, 7995, 8010, 8025, 8040, 8055, 8070, 8085, 8100, 8115, 8130, 8145, 8160, 8175, 8190, 8205, 8220, 8235, 8250, 8265, 8280, 8295, 8310, 8325, 8340, 8355, 8370, 8385, 8400, 8415, 8430, 8445, 8460, 8475, 8490, 8505, 8520, 8535, 8550, 8565, 8580, 8595, 8610, 8625, 8640, 8655, 8670, 8685, 8700, 8715, 8730, 8745, 8760, 8775, 8790, 8805, 8820, 8835, 8850, 8865, 8880, 8895, 8910, 8925, 8940, 8955, 8970, 8985, 9000, 9015, 9030, 9045, 9060, 9075, 9090, 9105, 9120, 9135, 9150, 9165, 9180, 9195, 9210, 9225, 9240, 9255, 9270, 9285, 9300, 9315, 9330, 9345, 9360, 9375, 9390, 9405, 9420, 9435, 9450, 9465, 9480, 9495, 9510, 9525, 9540, 9555, 9570, 9585, 9600, 9615, 9630, 9645, 9660, 9675, 9690, 9705, 9720, 9735, 9750, 9765, 9780, 9795, 9810, 9825, 9840, 9855, 9870, 9885, 9900, 9915, 9930, 9945, 9960, 9975, 9990, 10005, 10020, 10035, 10050, 10065, 10080, 10095, 10110, 10125, 10140, 10155, 10170, 10185, 10200, 10215, 10230, 10245, 10260, 10275, 10290, 10305, 10320, 10335, 10

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BY DATE

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 1 OF 1

CHKD. BY DATE

PROJECT

PROJECT

SUBJECT

1.01	1.54	17	1.54	0	0	04	1269	8
1.01	2.00	21	2.00	0	0	04	1269	8
1.01	2.08	21	2.08	0	0	04	1269	8
1.01	2.10	21	2.10	0	0	04	1269	8
1.01	2.18	21	2.18	0	0	04	1269	8
1.01	2.24	24	2.40	0	0	04	1269	8
1.01	2.30	25	2.50	0	0	04	1269	8
1.01	2.34	25	2.50	0	0	04	1269	8
1.01	2.40	27	2.70	0	0	04	1269	8
1.01	2.46	28	2.60	0	0	04	1269	8
1.01	2.54	29	2.90	0	0	04	1269	8
1.01	3.00	30	3.00	0	0	04	1269	8
1.01	3.08	31	3.10	0	0	04	1269	8
1.01	3.12	31	3.20	0	0	04	1269	8
1.01	3.18	33	3.30	0	0	04	1269	8
1.01	3.24	34	3.40	0	0	04	1269	8
1.01	3.30	35	3.50	0	0	04	1269	8
1.01	3.38	36	3.50	0	0	04	1269	8
1.01	3.42	37	3.70	0	0	04	1269	8
1.01	3.48	38	3.80	0	0	04	1269	8
1.01	3.54	39	3.90	0	0	04	1269	8
1.01	4.00	40	4.00	0	0	04	1269	8
1.01	4.06	41	4.10	0	0	04	1269	8
1.01	4.12	42	4.30	0	0	04	1269	8
1.01	4.18	43	4.30	0	0	04	1269	8
1.01	4.24	44	4.40	0	0	04	1269	8
1.01	4.30	45	4.50	0	0	04	1269	8
1.01	4.38	46	4.50	0	0	04	1269	8
1.01	4.42	47	4.70	0	0	04	1269	8
1.01	4.46	48	4.80	0	0	04	1269	8
1.01	4.54	49	4.90	0	0	04	1269	8
1.01	5.00	50	5.00	0	0	04	1269	8
1.01	5.06	51	5.10	0	0	04	1269	8
1.01	5.12	52	5.20	0	0	04	1269	8
1.01	5.18	53	5.30	0	0	04	1269	8
1.01	5.24	54	5.40	0	0	04	1269	8
1.01	5.30	55	5.50	0	0	04	1269	8
1.01	5.36	56	5.60	0	0	04	1269	8
1.01	5.42	57	5.70	0	0	04	1269	8
1.01	5.48	58	5.80	0	0	04	1269	8
1.01	5.54	59	5.90	0	0	04	1269	8
1.01	6.00	60	6.00	0	0	04	1269	8
1.01	6.06	61	6.10	4	0	04	1269	8
1.01	6.12	62	6.20	0	0	04	1269	8
1.01	6.18	63	6.30	12	0	04	1269	8
1.01	6.24	64	6.40	13	1	04	1269	8
1.01	6.30	65	6.50	13	1	05	1269	8
1.01	6.36	66	6.60	13	1	05	1269	8
1.01	6.42	67	6.70	13	1	05	1269	8
1.01	6.48	68	6.80	13	2	05	1269	8
1.01	6.54	69	6.90	13	2	05	1269	8
1.01	7.00	70	7.00	13	3	05	1269	8
1.01	7.06	71	7.10	13	3	05	1269	8
1.01	7.12	72	7.20	13	3	05	1269	8
1.01	7.18	73	7.30	13	3	05	1269	8
1.01	7.24	74	7.40	13	3	05	1269	8
1.01	7.30	75	7.50	13	3	05	1269	8
1.01	7.36	76	7.50	13	3	05	1269	8
1.01	7.42	77	7.70	13	4	05	1269	8
1.01	7.48	78	7.80	13	4	05	1269	8
1.01	7.54	79	7.90	13	4	05	1269	8
1.01	8.00	80	8.00	13	4	05	1269	8
1.01	8.06	81	8.10	13	4	05	1269	8
1.01	8.12	82	8.20	13	5	05	1269	8
1.01	8.18	83	8.30	13	5	05	1269	8
1.01	8.24	84	8.40	13	5	05	1269	8
1.01	8.30	85	8.50	13	5	05	1269	8
1.01	8.36	86	8.60	13	5	05	1269	8
1.01	8.42	87	8.70	13	5	05	1269	8
1.01	8.48	88	8.80	13	5	05	1269	8
1.01	8.54	89	8.90	13	5	05	1269	8
1.01	9.00	90	9.00	13	5	05	1269	8
1.01	9.06	91	9.10	13	5	05	1269	8
1.01	9.12	92	9.20	13	5	05	1269	8
1.01	9.18	93	9.30	13	5	05	1269	8
1.01	9.24	94	9.40	13	5	05	1269	8
1.01	9.30	95	9.50	13	5	05	1269	8
1.01	9.36	96	9.60	13	5	05	1269	8
1.01	9.42	97	9.70	13	5	05	1269	8
1.01	9.48	98	9.80	13	5	05	1269	8
1.01	9.54	99	9.90	13	5	05	1269	8
1.01	10.00	100	10.00	13	5	05	1269	8
1.01	10.06	101	10.10	13	5	05	1269	8
1.01	10.12	102	10.20	13	5	05	1269	8
1.01	10.18	103	10.30	13	5	05	1269	8
1.01	10.24	104	10.40	13	5	05	1269	8
1.01	10.30	105	10.50	13	5	05	1269	8
1.01	10.36	106	10.60	13	5	05	1269	8
1.01	10.42	107	10.70	13	5	05	1269	8
1.01	10.48	108	10.80	13	5	05	1269	8
1.01	10.54	109	10.90	13	5	05	1269	8
1.01	11.00	110	11.00	13	5	05	1269	8
1.01	11.06	111	11.10	13	5	05	1269	8
1.01	11.12	112	11.20	13	5	05	1269	8
1.01	11.18	113	11.30	13	5	05	1269	8
1.01	11.24	114	11.40	13	5	05	1269	8
1.01	11.30	115	11.50	13	5	05	1269	8
1.01	11.36	116	11.60	13	5	05	1269	8
1.01	11.42	117	11.70	13	5	05	1269	8
1.01	11.48	118	11.80	13	5	05	1269	8
1.01	11.54	119	11.90	13	5	05	1269	8
1.01	12.00	120	12.00	13	5	05	1269	8

BY DATE 4/25/81

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 11 OF 121

CHKD. BY DATE

PROJECT

SUBJECT

1 01	9 54	100	9 50	13	87	1270 1
1 01	10 00	100	10 00	13	87	1270 1
0 00	0 00	100	10 10	13	87	1270 1
0 00	0 00	100	10 20	13	87	1270 1
0 00	0 00	100	10 30	13	87	1270 1
0 00	0 00	100	10 40	13	87	1270 1
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0 00	0 00	100	10 60	13	87	1270 1
0 00	0 00	100	10 70	13	87	1270 1
0 00	0 00	100	10 80	13	87	1270 1
0 00	0 00	100	10 90	13	87	1270 1
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0 00	0 00	115	11 50	13	87	1270 1
0 00	0 00	116	11 60	13	87	1270 1
0 00	0 00	117	11 70	13	87	1270 1
0 00	0 00	118	11 80	13	87	1270 1
0 00	0 00	119	11 90	13	87	1270 1
0 00	0 00	120	12 00	13	87	1270 1
0 00	0 00	121	12 10	30	87	1270 1
0 00	0 00	122	12 20	54	87	1270 1
0 00	0 00	123	12 30	65	87	1270 2
0 00	0 00	124	12 40	69	87	1270 2
0 00	0 00	125	12 50	70	87	1270 3
0 00	0 00	126	12 60	71	87	1270 3
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0 00	0 00	128	12 80	71	87	1270 4
0 00	0 00	129	12 90	71	87	1270 4
0 00	0 00	130	13 00	71	87	1270 4
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0 00	0 00	134	13 40	85	87	1270 6
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0 00	0 00	137	13 70	85	87	1270 7
0 00	0 00	138	13 80	85	87	1270 7
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0 00	0 00	141	14 10	85	87	1270 8
0 00	0 00	142	14 20	102	87	1270 8
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0 00	0 00	144	14 40	108	87	1270 9
0 00	0 00	145	14 50	109	87	1270 9
0 00	0 00	146	14 60	109	87	1271 0
0 00	0 00	147	14 70	109	87	1271 0
0 00	0 00	148	14 80	109	87	1271 0
0 00	0 00	149	14 90	109	87	1271 1
0 00	0 00	150	15 00	109	87	1271 1
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0 00	0 00	152	15 20	115	87	1271 1
0 00	0 00	153	15 30	130	87	1271 2
0 00	0 00	154	15 40	172	87	1271 2
0 00	0 00	155	15 50	234	87	1271 3
0 00	0 00	156	15 60	530	102	1271 6
0 00	0 00	157	15 70	576	105	1271 9
0 00	0 00	158	15 80	594	107	1272 1
0 00	0 00	159	15 90	258	108	1272 2
0 00	0 00	160	16 00	258	108	1272 1
0 00	0 00	161	16 10	218	107	1272 1
0 00	0 00	162	16 20	115	106	1272 0
0 00	0 00	163	16 30	106	106	1272 0
0 00	0 00	164	16 40	103	105	1271 9
0 00	0 00	165	16 50	102	105	1271 9
0 00	0 00	166	16 60	101	105	1271 9
0 00	0 00	167	16 70	102	104	1271 6
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0 00	0 00	169	16 90	101	103	1271 6
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0 00	0 00	176	17 60	101	103	1271 6
0 00	0 00	177	17 70	101	103	1271 6
0 00	0 00	178	17 80	101	103	1271 6
0 00	0 00	179	17 90	101	103	1271 6
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0 00	0 00	181	18 10	101	103	1271 6
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0 00	0 00	183	18 30	101	103	1271 6
0 00	0 00	184	18 40	101	103	1271 6
0 00	0 00	185	18 50	101	103	1271 6
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0 00	0 00	187	18 70	101	103	1271 6
0 00	0 00	188	18 80	101	103	1271 6
0 00	0 00	189	18 90	101	103	1271 6
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0 00	0 00	196	19 60	101	103	1271 6
0 00	0 00	197	19 70	101	103	1271 6
0 00	0 00	198	19 80	101	103	1271 6
0 00	0 00	199	19 90	101	103	1271 6
0 00	0 00	200	20 00	101	103	1271 6

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BY LS DATE 12-21-68
 CHKD. BY DATE
 SUBJECT 5-2

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 11 OF 11
 PROJECT 1270

0 00	0 00	179	17 40	79	111	100	1271 4
0 00	0 00	180	18 00	79	109	100	1271 4
0 00	0 00	181	18 10	57	106	79	1271 4
0 00	0 00	182	18 20	20	101	79	1271 3
0 00	0 00	183	18 30	10	95	78	1271 1
0 00	0 00	184	18 40	5	88	90	1271 2
0 00	0 00	185	18 50	3	82	90	1271 1
0 00	0 00	186	18 60	2	76	90	1271 1
0 00	0 00	187	18 70	2	70	90	1271 0
0 00	0 00	188	18 80	2	64	90	1270 9
0 00	0 00	189	18 90	2	58	90	1270 9
0 00	0 00	190	19 00	2	50	94	1270 8
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0 00	0 00	192	19 20	2	53	93	1270 7
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0 00	0 00	199	19 90	2	37	91	1270 5
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0 00	0 00	205	20 50	2	27	89	1270 3
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0 00	0 00	207	20 70	2	24	89	1270 3
0 00	0 00	208	20 80	2	23	89	1270 3
0 00	0 00	209	20 90	2	22	89	1270 3
0 00	0 00	210	21 00	2	20	88	1270 2
0 00	0 00	211	21 10	2	19	88	1270 2
0 00	0 00	212	21 20	2	18	88	1270 2
0 00	0 00	213	21 30	2	17	88	1270 2
0 00	0 00	214	21 40	2	17	88	1270 2
0 00	0 00	215	21 50	2	16	88	1270 2
0 00	0 00	216	21 60	2	15	88	1270 2
0 00	0 00	217	21 70	2	14	87	1270 1
0 00	0 00	218	21 80	2	12	87	1270 1

PEAK OUTFLOW IS 279-280 AT TIME 18 90 HOURS

CFS	280	105	33	33	7923
CMS	2	3	1	1	274
INCHES		8 16	10 24	10 24	10 24
MM		207 29	260 01	260 01	260 01
AC-FT		52	65	65	65
THOUS. CU M		64	81	81	81

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PEAK-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS				
OPERATION	STATION	AREA	PLAN	RATIO 1 0 50
HYDROGRAPH AT	1	0 12	1	576
	(0 21)	(15 24)
ROUTED TO	2	0 12	1	280
	(0 21)	(7 93)

SUMMARY OF DAM SAFETY ANALYSIS

ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM	
STORAGE		1279 0		1277 50		1272 00	
OUTFLOW		80		84		108	
		5		6		162	
RATIO OF FPE CFS	PEAK FLOW CFS	PEAK FLOW CFS	PEAK FLOW CFS	PEAK FLOW CFS	PEAK FLOW CFS	TIME OF PEAK OUTFLOW HOURS	TIME OF FAILURE HOURS
0 50	279-280	280	280	280	280	18 90	0 00

SHEET NO. 2 OF 2

PROJECT 22

Y	65	1202	82	1212	110	1215
W	82					

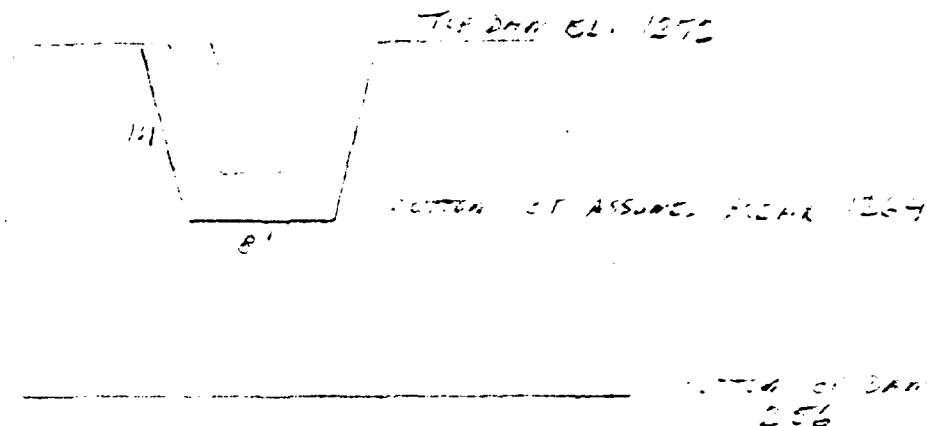
PLAN	STATION	TIME	ELEVATION
1	1257.1	16:10	1253.2
2	1257.2	16:10	1253.2

BY _____ DATE _____
 CHKD. BY _____ DATE _____
 SUBJECT _____

LOUIS BERGER & ASSOCIATES INC.

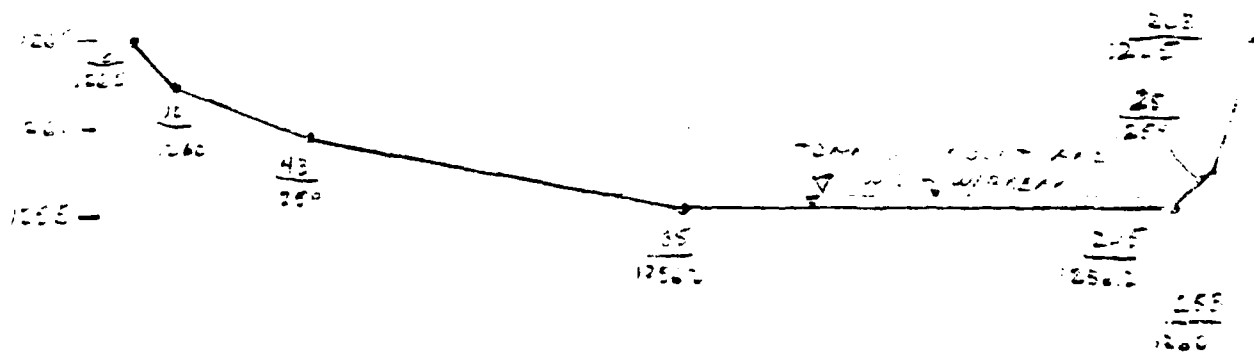
SHEET NO. 1 OF 14
 PROJECT _____

DAM BREAK DATA



2. DOWNSTREAM CANYON-SECTION

REACH 2-3 — 550' DOWNSTREAM INCLUDE TERRACE CORNER



REACH 3-4 — 650' DOWNSTREAM

